MONROE SIMPLIFIED METHOD FOR EXTRACTING SQUARE ROOT

With the table of factors, the Monroe method of extracting square roots is a simple process of division and can be performed with any model of the Monroe Calculator. It gives accuracy to five significant digits in the root with an error of less than 5 in the sixth digit. On a Monroe Calculator with ten column keyboard, the root can be carried out to ten digits.

INSTRUCTIONS

The Monroe Method

To find $\sqrt{n}$ first determine N′ as follows:

For n between 1 and 100 inclusive, take $n = N'$

For n less than 1 or greater than 100, move the decimal point to the right or left in steps of two digits to arrive at N′ between 1 and 100.

Find the two consecutive values in the N′ column of the table between which N′ lies and select the values of A and D between the two selected N′ values.

Step 1 Set n on the extreme left of the keyboard and enter as dividend.

Step 2 Set A, from the table, on the extreme left of the keyboard and add.

Step 3 Set D, from the table, on the extreme left of the keyboard and divide.

The result in the upper dials of the Monroe, after decimal is pointed off, is the square root with an error of less than 5 in the sixth digit.

Pointing Off Decimals in Roots

If n is greater than 1, start at the decimal point and working to the left set off n into groups of two digits each. The number of such two digit groups to the left of the decimal point will be the number of digits to the left of the decimal point in the root. If the extreme left-hand group consists of only one figure, it should be counted as though a complete group.

If n is less than 1, start at the decimal point and working to the right set off the zeros preceding the first significant figure into groups of two zeros each. The number of such groups will be the number of zeros that should follow the decimal point and precede the first significant figure in the root. If the last right-hand group consists of only one zero, it should NOT be counted as a group.

Example I

$\sqrt{6942.3214} = 83.321$

Step 1 Move decimal in n to left, 69.423214, which is between 69.3 and 70.4 in N′ column of table. From table, A = 69889 and D = 1672.

Step 2 Set 69423214 on the extreme left of the keyboard and enter in the extreme left of the lower dials as a dividend.

Step 3 Set A, 69889 on extreme left of keyboard and add.

Step 4 Set D, 1672 on extreme left of keyboard and divide.

Result Upper dials 833207 or 83321

Inserting the decimal point gives the root, 83.321.

The decimal point in the root is determined by setting off the whole number 6942 into groups of two digits each, 69′42. Since there are two groups, there are, according to the rule, two whole number digits in the root, thus 83.321.

Example II

$\sqrt{0.000003912} = 0.0019779$

Step 1 Move decimal in n to right, 3.912. From table, A = 3863 and D = 3931.

Step 2 Set 3912 on extreme left of the keyboard and enter in the lower dials as a dividend.

Step 3 Set 3863 on extreme left of the keyboard and add.

Step 4 Set 3931 on extreme left of the keyboard and divide.

Result Upper dials 1977868 or 19779

Inserting the decimal point gives the root 0.0019779. The decimal point is determined by counting the number of full pairs of zeros to the immediate right of the decimal point in 0.00′00′03912. Since there are two such pairs of zeros (disregard the fifth zero) two zeros should follow the decimal point and precede the first significant figure of the root, thus 0.0019779.

Example III

$\sqrt{207.08425}$ to ten significant figures = 14.39042217

Step 1 Move decimal in n to left, 2.0708425. From table, A = 2042 and D = 2858.

Step 2 Set 20708425 on extreme left of keyboard and enter as a dividend.

Step 3 Set 2042 on extreme left of keyboard and add.

Step 4 Set 2858 on extreme left of keyboard and divide.

Result Upper dials 143906 or 14.391, root to five significant figures

To carry out to ten significant figures, continue as follows:

Step 5 Clear upper and lower dials. Disregarding decimal, set radicand 20708425 on extreme left of keyboard and enter as dividend.

Step 6 Set 14391, root to five places without decimal, on extreme left of keyboard and divide.

Result Upper dials 1438984434

Step 7 Average 1438984434 with the first approximation, 14391, by adding 1438984434 and 14391 with the left-hand digits aligned to obtain the total, 2878084434, and divide that figure by 2.

Result Upper dials 1439042217, when pointed off, 14.39042217, root with maximum possible error of 1 in the tenth place

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MONROE TABLE OF FACTORS FOR

SIMPLIFIED METHOD FOR EXTRACTING SQUARE ROOT

For accuracy to five significant digits in roots with an error of less than 5 in the sixth digit

N′	A	D
1.000		
1.045	102	202
1.09	1067	2066
1.14	1114	2111
1.19	1162	2156
1.24	1211	2201
1.28	126	2245
1.327	1303	2283
1.385	1356	2329
1.45	1416	238
1.515	1481	2434
1.575	1545	2486
1.645	1609	2537
1.705	1677	259
1.777	1741	2639
1.855	1817	2696
1.94	1896	2754
2.01	1974	281
2.08	2042	2858
2.16	2114	2908
2.222	2177	2951
2.29	2259	3006
2.38	2327	3051
2.47	2421	3112
2.57	252	3175
2.676	2621	3238
2.78	2729	3304
2.885	2829	3364
2.99	2936	3427
3.09	3038	3486
3.22	3154	3552
3.352	3285	3625
3.457	3404	369
3.59	3523	3754
3.71	3648	382
3.80	3777	3887
3.94	3863	3931
4.05	3996	3998
4.13	4056	4028
4.26	4188	4093
4.40	432	4157
4.54	4471	4229
4.705	4618	4298
4.87	4785	4375
5.035	4946	4448
5.225	513	453
5.39	5306	4607
5.56	5459	4673
5.74	565	4754
5.93	5832	483
6.12	6017	4906
6.29	62	498
	6383	5053

N′	A	D
6.29	6383	5053
6.49	6579	513
6.69	6791	5212
6.905	7017	5298
7.132	7244	5383
7.35	745	5459
7.56	7681	5543
7.80	7924	563
8.05	8168	5716
8.285	8404	5798
8.53	8661	5886
8.795	8922	5974
9.00	9102	6034
9.24	9345	6114
9.485	9619	6203
9.77	9894	6291
10.0	1009	6353
10.2	1032	6425
10.45	1053	649
10.6	1066	653
10.8	1086	6591
11.0	11122	667
11.2	1136	6741
11.5	1157	6803
11.7	1183	6879
11.9	1202	6934
12.1	1218	698
12.3	1245	7057
12.5	1262	7105
12.75	1287	7175
12.9	1305	7225
13.2	13286	729
13.4	1352	7354
13.7	1379	7427
13.9	1401	7486
14.1	1419	7534
14.3	1436	7579
14.5	146	7642
14.7	1488	7715
15.08	1528	7818
15.45	1563	7907
15.8	1596	799
16.0	1616	804
16.35	1652	8129
16.7	169	8222
17.1	1721	8297
17.35	1756	8381
17.75	1788	8457
18.05	1819	853
18.4	1858	8621
18.8	1897	8711
19.2	1932	8791

N′	A	D
19.2	1932	8791
19.55	1978	8895
20.0	2016	898
20.3	2043	904
20.65	2088	9139
21.0	211	9187
21.3	2152	9278
21.7	2186	9351
22.1	2233	9451
22.5	227	9529
22.95	2316	9625
23.3	2343	9681
23.6	2379	9755
24.0	2427	9853
24.55	248	996
25.0	252	1004
25.5	2574	10147
26.0	2626	10249
26.55	26832	1036
27.1	2741	10471
27.72	27984	1058
28.25	2851	10679
28.8	29052	1078
29.3	2955	10872
29.8	3003	1096
30.2	3047	1104
30.8	31136	1116
31.45	31753	1127
32.05	3237	11379
32.7	33062	115
33.44	33698	1161
33.9	34222	117
34.6	3491	11817
35.2	35402	119
35.78	3606	1201
36.3	36602	121
37.0	37271	1221
37.5	37822	123
38.2	38502	1241
38.8	39062	125
39.4	3974	12608
40.0	40322	127
40.7	4103	12811
41.45	41796	1293
42.1	4251	1304
42.9	4323	1315
43.7	4389	1325
44.3	44689	1337
45.0	4536	1347
45.7	4609	13578
46.5	46922	137
47.35	47679	1381

N′	A	D
47.35	47679	1381
48.0	48302	139
48.75	4914	1402
49.5	4985	14121
50.35	5073	14245
51.1	5148	1435
51.8	522	1445
52.7	5318	14585
53.6	54022	147
54.5	54908	1482
55.2	55502	149
56.0	564	1502
56.83	5738	1515
57.9	5843	15288
59.0	59444	1542
59.85	6038	15541
60.95	61465	1568
62.0	6252	15814
63.1	636	1595
64.0	644	1605
65.0	6548	16184
66.0	66585	1632
67.2	6765	1645
68.25	6879	16588
69.3	69889	1672
70.4	7098	1685
71.4	7191	1696
72.5	73102	171
73.73	7439	1725
75.0	7549	17377
76.0	76562	175
77.2	7788	1765
78.5	79032	1778
79.5	80102	179
80.6	8109	1801
81.6	8221	18134
82.8	8321	18244
83.7	8418	1835
84.6	851	1845
85.5	8584	1853
86.4	8689	18643
87.4	8789	1875
88.3	8883	1885
89.4	8968	1894
90.0	9044	1902
91.0	9168	1915
92.1	9264	1925
93.3	9406	19397
94.6	9516	1951
95.75	9653	1965
97.1	9792	19791
98.6	994	1994
100.0		

See reverse for instructions for the use of this table

Form 1228-S